

# Discrete Mathematics

## Problem Set 7

### Propositional Logic

1. Prove that  $p \oplus q \equiv (p \wedge \neg q) \vee (\neg p \wedge q)$ .
2. Prove Idempotent Laws
  - (a)  $p \wedge p \equiv p$
  - (b)  $p \vee p \equiv p$
3. Prove Absorption Laws
  - (a)  $p \wedge (p \vee q) \equiv p$
  - (b)  $p \vee (p \wedge q) \equiv p$
4. Prove the associative laws by comparing truth tables for the two expressions asserted in (AL1) and (AL2) to be equivalent.
5. Prove the distributive laws (DL1) and (DL2).
6. Using a truth table, determine whether each of the following compound propositions is satisfiable (i.e. at least one truth assignment satisfies it), a tautology (every truth assignment satisfies it), or unsatisfiable (no truth assignment satisfies it).
  - (a)  $p \implies (p \vee q)$
  - (b)  $\neg(p \implies (p \vee q))$
  - (c)  $p \implies (p \implies q)$
7. Using truth tables, determine which of the following compound propositions are tautologies.

(a)  $p \implies (p \vee q)$

(b)  $\neg(p \implies q)$

(c)  $p \implies (p \implies q)$